WHAT IS CLAIMED IS:

1. An acoustic matching member that is incorporated into an ultrasonic transducer for transmitting and receiving ultrasonic waves, comprising:

at least two layers including a first layer and a second layer that have different acoustic impedance values from each other;

wherein the first layer is made of a composite material of a porous member and a filling material supported by void portions of the porous member, the second layer is made of the filling material or the porous member, and the first layer and the second layer are present in this stated order.

2. The acoustic matching member according to claim 1, wherein the second layer is made of a filling material, which has continuity with the filling material of the first layer.

3. The acoustic matching member according to claim 1, wherein the second layer is made of a porous member, which has continuity with the porous member of the first layer.

4. The acoustic matching member according to claim 1, wherein an acoustic impedance Z1 of the first layer and an acoustic impedance Z2 of the second layer have the following relationship:

$Z1>Z2$.

5. The acoustic matching member according to claim 1, wherein an apparent density $\rho 1$ of the first layer and an apparent density $\rho 2$ of the second layer have the following relationship:

$\rho 1>\rho 2$.

6. The acoustic matching member according to claim 1, wherein at least one of the porous member and the filling material is made of an inorganic substance.

7. The acoustic matching member according to claim 6, wherein the porous member is a sintered porous member of ceramic or a mixture of

ceramic and glass.

8. The acoustic matching member according to claim 6, wherein the filling material is a dry gel made of an inorganic oxide.

9. An ultrasonic transducer that transmits and receives ultrasonic waves, comprising an acoustic matching member and a piezoelectric member,

wherein the acoustic matching member comprises at least two layers including a first layer and a second layer that have different acoustic impedance values from each other,

the first layer is made of a composite material of a porous member and a filling material supported by void portions of the porous member, the second layer is made of the filling material or the porous member, and the first layer and the second layer are present in this stated order, and

the piezoelectric member is disposed on a side of the first layer of the acoustic matching member.

10. The ultrasonic transducer according to claim 9, wherein the piezoelectric member is disposed on an inner surface of a closed container, and the first layer of the acoustic matching member is disposed on an outer surface of the closed container at a position opposed to a disposed position of the piezoelectric member.

11. The ultrasonic transducer according to claim 10, wherein the closed container is made of a metal material.

12. An ultrasonic flowmeter comprising ultrasonic transducers that transmit and receive ultrasonic waves, each of the ultrasonic transducers comprising an acoustic matching member and a piezoelectric member, wherein

the acoustic matching member comprises at least two layers including a first layer and a second layer that have different acoustic impedance values from each other,

the first layer is made of a composite material of a porous member and a filling material supported by void portions of the porous member, the second layer is made of the filling material or the porous member, and the

first layer and the second layer are present in this stated order, and

the piezoelectric member is disposed on a side of the first layer of the acoustic matching member to form each ultrasonic transducer, and

the ultrasonic flowmeter further comprising:

a measurement tube comprising a flow path through which fluid to be measured flows, a pair of the ultrasonic transducers being disposed in the measurement tube on an upstream side and a downstream side relative to the flow of the fluid to be measured so as to oppose each other;

a transmission circuit for causing the ultrasonic transducers to transmit ultrasonic waves;

a reception circuit for processing ultrasonic waves received by the ultrasonic transducers;

a transmission/reception switching circuit for switching between transmission and reception of the pair of ultrasonic transducers;

a circuit for measuring a time for ultrasonic waves to propagate between the pair of ultrasonic transducers; and

a calculation unit that converts the propagation time into a flow rate of the fluid to be measured.

13. A method for manufacturing an acoustic matching member, the acoustic matching member comprising at least two layers including a first layer and a second layer that have different acoustic impedance values from each other, the first layer being made of a composite material of a porous member and a filling material supported by void portions of the porous member, the second layer being made of the filling material or the porous member, and the first layer and the second layer being present in this stated order, the method comprising the steps of:

(a) filling voids of a porous member with a fluid filling material whose volume after solidification is not less than a volume of the voids of the porous member; and

(b) solidifying the fluid filling material inside of the voids and the surplus fluid filling material at the same time.

14. A method for manufacturing an acoustic matching member, the acoustic matching member comprising at least two layers including a first layer and a second layer that have different acoustic impedance values from each other, the first layer being made of a composite material of a porous

member and a filling material supported by void portions of the porous member, the second layer being made of the filling material or the porous member, and the first layer and the second layer being present in this stated order, the method comprising the steps of:

(a) filling at least one portion of voids of a porous member with a fluid filling material; and

(b) solidifying the fluid filling material inside of the voids.

15. A method for manufacturing an ultrasonic transducer for transmitting or receiving ultrasonic waves, the ultrasonic transducer comprising an acoustic matching member and a piezoelectric member, the acoustic matching member comprising at least two layers including a first layer and a second layer that have different acoustic impedance values from each other, the first layer being made of a composite material of a porous member and a filling material supported by void portions of the porous member, the second layer being made of the filling material or the porous member, and the first layer and the second layer being present in this stated order, the method comprising the step of:

attaching a side of the first layer of the acoustic matching member to a surface of the piezoelectric member or to an outer surface of a closed container at a position opposed to a disposed position of the piezoelectric member.

16. A method for manufacturing an ultrasonic transducer for transmitting or receiving ultrasonic waves, the ultrasonic transducer comprising an acoustic matching member and a piezoelectric member, the acoustic matching member comprising at least two layers including a first layer and a second layer that have different acoustic impedance values from each other, the first layer being made of a composite material of a porous member and a filling material supported by void portions of the porous member, the second layer being made of the filling material or the porous member, and the first layer and the second layer being present in this stated order, the method comprising the steps of:

(a) attaching the porous member that does not contain the filling material to a surface of the piezoelectric member or to an outer surface of a closed container at a position opposed to a disposed position of the piezoelectric member; and

(b) then filling the porous member with a fluid filling material and solidifying the fluid filling material.